Deloitte Access Economics

Australian Energy Regulator

Gas demand forecast for Jemena's NSW network

24 November 2014

Contents

Charts

Liability limited by a scheme approved under Professional Standards Legislation.

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee, and its network of member firms, each of which is a legally separate and independent entity.
Please see www.deloitte.com/au/about for a detailed description of the legal structure of Deloitte Touche Tohmatsu Limited and its member firms.

© 2014 Deloitte Access Economics Pty Ltd

Tables

Glossary

AER	Australian Energy Regulator
E TO G	Electricity to Gas
GJ	Gigajoules
GSP	Gross State Product
I&C	Industrial and Commercial
JGN	Jemena Gas Networks (NSW)
TJ	Terajoules

Executive Summary

Deloitte Access Economics has been engaged by the AER to develop an alternative demand forecast for Jemena's NSW gas network. This alternative forecast incorporates the findings from Deloitte Access Economics' review of forecasts prepared by Core Energy Group for Jemena, Core's response to this review and further considerations put forward by the AER.

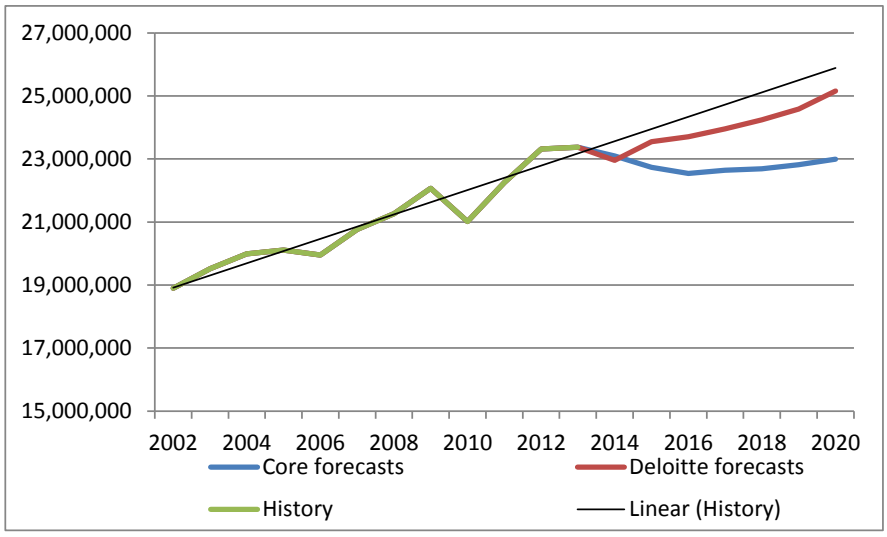
Our alternative forecast produces higher usage than that predicted by Core. A key reason for this is the nature of the model used to forecast per customer usage. Under Core's approach the per customer forecast is based on historic trends (i.e. where demand is primarily a function of demand in the previous year plus a trend factor). The impact of changes in gas (and electricity) prices are then applied as post-model adjustments. This results in a sharp decline in per customer usage.

In contrast, our econometric approach to calculating per customer usage explicitly reflects changes in state final demand and gas prices within the model. A consequence is that the improved economic outlook for NSW offsets to a large degree the impact of forecast higher gas prices and hence our forecast per customer usage is greater than Core. Our forecasts are summarised below.

Residential usage forecast

We agree with Core that total residential usage is likely to grow more slowly than the historic trend, despite an increase in new residential connections. However, we believe that rather than falling as forecast by Core, total consumption will continue to grow, albeit at a slower rate than has historically been the case.

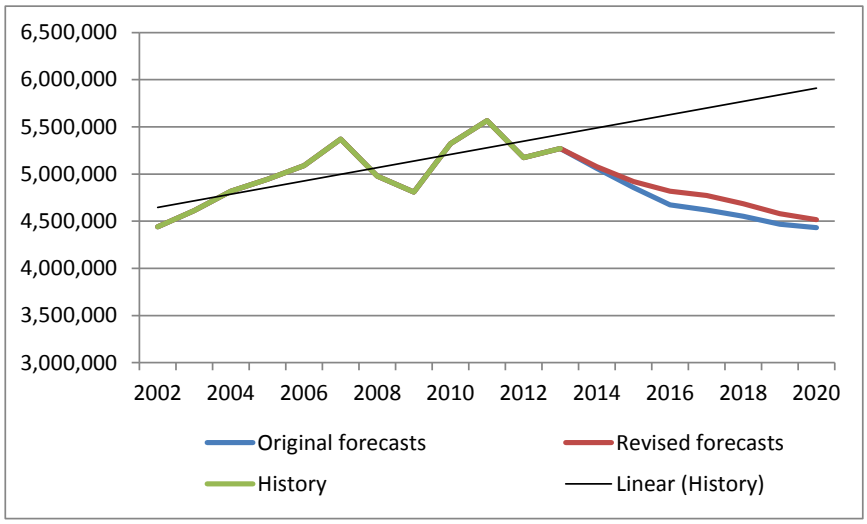
Chart E1 Residential usage forecast (GJ)



Small business usage forecast

There has been a strong average reduction in small business usage per customer in recent years. However this has been more than offset by increases in customer numbers, which averaged 6.4% per annum from 2003 to 2013. With a likely moderation in customer numbers (growth is estimated to be only 2% from 2013 to the end of the regulatory period) we consider it likely that total small business usage will fall over the period.

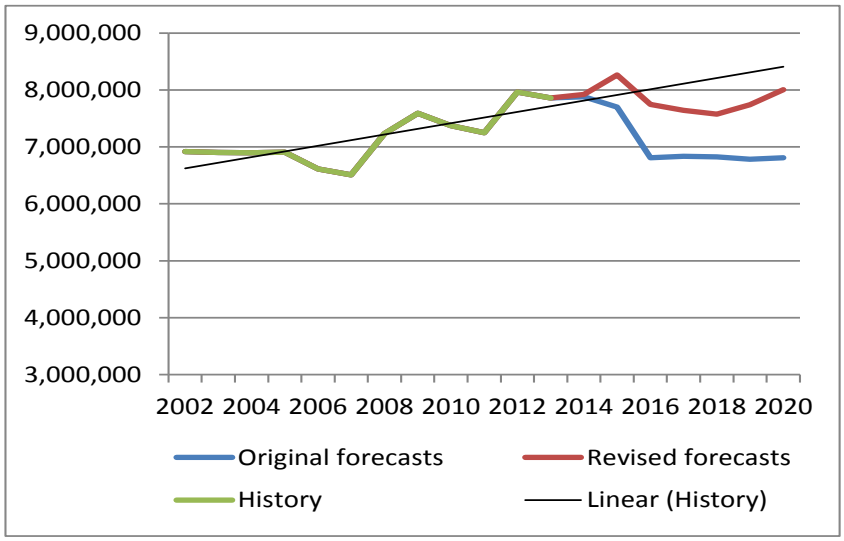
Chart E2 Small business usage forecast (GJ)



I&C usage forecast

Similarly to residential usage, we agree with Core that usage will not grow in line with the historic trend. However, we believe the original reductions forecast by Core are too high.

Chart E3 I&C usage forecast (GJ)



Refining the forecast

The forecast is driven to some extent by the impact of retail gas and electricity price changes. There is also some circularity here in respect of the AER's revenue determinations, both in respect of the JGN gas network but also in respect of NSW electricity distribution prices. Hence we suggest that the forecast be reviewed in light of the AER's decision and any other information regarding gas prices that may be available.

Secondly, we note that the forecast is based on 2012/13 actual data and 2013/14 is based on forecast rather than actual data. We suggest that the forecast be updated with the 2013/14 information as part of the AER's final decision process.

Deloitte Access Economics

1 Introduction

This report presents revised consumption forecasts for the Tariff V customer group for Jemena's NSW gas distribution network. The revised forecasts build on earlier work conducted by Deloitte Access Economics (Deloitte) in respect of the forecasts, and reflect Jemena's response to this work as well as additional comments from the AER.

1.1 Assessment of reasonableness of Jemena's consumption forecasts

In August 2014 Deloitte was engaged by the AER to perform a high level review of Jemena's gas demand forecast. Jemena's forecasts were largely prepared by the Core Energy Group (Core).

In undertaking this work (referred to here as the 'original report') Deloitte Access Economics:

- Undertook a desktop review of the information provided to us. This included the following confidential information:
    - JGN's 2015-20 Access Arrangement Information, Appendix 5.1; and
    - A number of Excel models including weather normalisation calculations.
- Provided a number of questions which we discussed with Jemena and Core on 25 and 28 July 2014.

We concluded that the approach adopted by Core was transparent, clear and generally sound in terms of methodology. However there were a number of areas where Deloitte Access Economics considered the forecasts to not necessarily represent the best forecast of demand in the circumstances.

The AER subsequently asked Deloitte to prepare an alternative forecast. To do so we have used the same general framework as Core, and indeed have used the Excel model provided by Core to calculate the alternative forecast.

1.1.1 Scope and approach

In light of our findings and Core and Jemena's responses, Deloitte has been asked to produce a revised set of forecasts. In particular, we were asked to produce:

1. An alternative demand forecast, which encapsulates:

- the material produced by Deloitte Access Economics in the first stage of the consultancy, including:
    - the report 'Review of Core Energy Group gas demand forecast for Jemena's NSW network'; and
    - the spreadsheet 'Alternative assumptions.xlsx'.
- Core's response to the initial Deloitte report.

- JGN's subsequent advice regarding carbon cost removal.
- Deloitte's consideration of the Core response.
- AER further considerations – set out below – incorporated as Deloitte considers appropriate.

2. A draft and final report substantiating the assumptions and method applied in arriving at the alternative demand forecast.

AER further considerations:

- Exclusion of a data point ('Alternative assumptions.xlsx', tab 'residential', cell f81) from trend calculation ('Alternative assumptions.xlsx', tab 'residential', cells r83:r84).
- Inclusion of the trend information in calculating connections for E to G connections ('Alternative assumptions.xlsx', tab 'residential', cells s81:y81). Core's approach currently only draws on the last available connections data point and applies the reduced marketing impact. The AER considers that the trend information should be incorporated into the E to G connections forecast.
- Inclusion of step change expenditure in the change in marketing spend for consistent treatment and transparency ('Alternative assumptions.xlsx', tab 'residential', cells s89:y89).
- Whether including cross price elasticity (demand impacts) and marketing effectiveness (connections) is overstating the changes attributable to decreasing gas/electricity price differentials.

1.1.2 Limitations

In preparing our alternative demand forecast we have assumed that the information provided to us in the course of this assignment is accurate and complete.

Further, we have used the Excel model provided by Core as the basis for our re-forecast. We have not undertaken an 'audit' or any other assurance review of the information provided, including in relation to the integrity of the Excel model.

1.1.3 Structure of this report

This report presents the alternative methodology and alternative forecasts produced. The remainder of this report is structured as follows:

- Chapter 2 provides an overview of Core's modelling approach as well as the approach we have used to develop the forecasts;
- Chapter 3 presents the alternative customer number forecasts;
- Chapter 4 presents the alternative consumption per customer forecasts; and
- Chapter 5 presents the alternative total consumption forecasts.

In general this report focuses on the major assumptions and approaches used by Core, as well as those areas where we believe an alternative approach has merit. As a result it does not dwell on all aspects of the forecast, including areas where we are satisfied with the approach adopted. These include the weather normalisation undertaken (both in terms of historic normalisation and the future weather forecast) and the Tariff D forecast.

2 Approach to forecasting

This Chapter first summarises the approach used by Core to prepare its forecast of usage. It then provides an overview of the alternative methodology utilised to develop the revised forecasts of gas consumption. In particular, it presents the revised modelling assumptions – specifically around price and customer numbers – and the modified econometric approach used to construct the forecasts.

2.1 The Core forecasting approach

Core's approach to forecasting gas usage by Tariff V customers is summarised below:

- The tariff V market was segmented into residential, small business and Industrial and Commercial (I&C) groups, and the residential market was further segmented into existing, new estates, medium density/high rise and electricity to gas customers
- Historic demand was normalised to remove the impact of weather and to derive a per customer forecast based on historic trends (i.e. where demand is primarily a function of demand in the previous year plus a trend factor)
- Because Core considered historic trends will not be replicated going forward historic trends were adjusted. These adjustments primarily relate to the impact of changes in gas and electricity prices.

Key assumptions/outputs that characterise Core's Tariff V forecast are:

- Sharply increased connection of new dwellings compared to recent history, but lower electricity to gas (E to G) conversions
- A higher proportion of medium and high density connections compared to recent history
- An increase in new non-residential connections
- A small increase in residential disconnections
- A reduction (in addition to the trend reduction) in per customer demand due both to higher gas prices (own-price elasticity) and (relatively) lower electricity prices (cross-price elasticity).

In preparing the JGN forecasts Core did not include Gross State Product (GSP) (or state final demand) as an explanatory variable, noting that although it is possible some statistical correlation may exist between usage and GSP in the current period, many other factors – the decline of manufacturing, changing energy policies, more efficient houses, the installation of solar panels, etc. - were logically likely to have a more material impact. Thus in Core's view any GSP impact was likely to be swamped by these other factors.

For Tariff D customers Core's forecast uses 2013 Chargeable Demand (CD) as a baseline then adjusts for:

- Net known new customers and disconnections and associated loads as advised by JGN (including based on a survey of the top 20 customers)
- Reallocations of demand between Tariff D and Tariff V as advised by JGN.

2.2 The Core forecasting approach

There is no single accepted approach to forecasting gas usage in Australia. However in June 2014 ACIL Allen Consulting (ACIL Allen) prepared a report for the Australian Energy Market Operator (AEMO) proposing a methodology for forecasting gas consumption in eastern and south eastern Australia.[1] The methodology proposes using an econometric approach to forecast consumption by residential, business and small industrial consumers, and use of a survey approach for large industrial consumers. While the demand forecasting methodology is designed for a specific purpose – the preparation of the inaugural National Gas Forecast Report – we believe it is also largely appropriate for the purpose of preparing demand forecasts for Access Arrangements.

Core's approach is consistent with ACIL Allen's recommendations in that it uses a simple econometric trend approach for small (Tariff V) customers, and a survey approach for large (Tariff D) customers. Other points of similarity (and difference include):

- ACIL Allen notes that use of a weather factor (EDD or HDD) is important. Core has used an EDD approach in this case
- The customer segmentation adopted by Core (residential, small business, I&C, industrial, with sub-categories within the residential category) is consistent with ACIL Allen's recommendations
- ACIL Allen notes that a price elasticity of demand of -0.3 was accepted by the AER in 2012 (and has been proposed for residential customers by Core) but there is some possibility that in using this value could double count the impact of price increases
- ACIL Allen suggests that economic activity (measured by GSP) and population are typically the most relevant drivers of gas demand. Core has not explicitly included economic activity in its forecast.

The ACIL Allen methodology raises the possibility of using post-modelling adjustments where there is a reason to believe that historic relationships are likely to change in future. ACIL Allen notes that two key candidates for post-model adjustment are the shift from gas to electricity for space heating, and increases in the price of gas, in particular relative to the price of electricity, although in both cases ACIL Allen cautions that post-modelling amendments may not be the theoretically best way to approach the task.

Some of the above matters are discussed further in subsequent sections, and in particular the use of GSP in the forecasting process, but broadly we are satisfied that the overall approach by Core is sound. In particular we note that for the most part the forecast (as contained in the confidential reports and Excel files) is transparent and the methodology adopted is clear.

2.3 Revised assumptions

In general we agree with Core's view that forecast changes in energy prices will have an impact on gas usage over the forthcoming period. Historic trends are unlikely to be replicated going forward. We agree that per customer usage is likely to continue to fall, and

[1] ACIL Allen Report to AEMO, Gas Consumption Forecasting – A Methodology, 24 June 2014.

possibly at a faster rate than in the past. However, our view is that the Core forecasts are unduly low and do not take into account all the factors influencing gas use.

We also have concerns with the econometric approach adopted by Core, including that it does not reflect broader economic activity.

2.3.1 Econometric analysis

There are two potential econometric approaches to forecasting energy consumption – the structural (economic) approach which incorporates a range of potential explanatory variables in an attempt to understand the drivers of consumption, and the time series approach which models consumption trends. If the underlying trends in the drivers of consumption – particularly price and economic conditions – are expected to be maintained over the forecast period then the time series approach will provide a good approximation of future consumption. If, however, there is expected to be a deviation from trend – such as a sharp rise in prices or a revival in economic conditions – then the time series approach will not produce representative forecasts. [2]

Core's approach is based on a time series model, with future consumption driven by trends over the last decade, adjusted (off-model) for prices. Due to the influence of historical trends, Core found that measures of economic conditions did not add value to the time series model. As explained above, by developing the forecasts using a time series approach, we are concerned that Core has not adequately controlled for the expected changes in the drivers of gas consumption over the forecast period. In particular, during the historical period used to support the trend analysis (2002 to 2013), NSW gas consumption was subject to the considerable economic changes brought on by the global financial crisis; going forward, however, NSW's economy is expected to strengthen and return to trend growth (see Chart 2.1 and Chart 2.2 below). By not explicitly accounting for the effect of improving economic conditions on gas demand, Core's time series model has likely under-forecast consumption over the Review period[3].

In contrast, the econometric analysis adopted by Deloitte is based on a structural model of consumption, with prices and economic conditions included within the econometric model. Given the expected changes to gas prices over the next five years, as well as the considerable economic changes that have occurred since 2008, the structural approach was deemed more appropriate for developing gas consumption forecasts over the Review Period.

The modelling was applied to consumption per customer for each customer type and model selection was based on the in-sample forecast accuracy of each regression[4] as well as the standard model-fit tests of coefficient t-statistics, R-squared, and F-statistics.

[2] Core did include price effects as a post-model adjustment and while this is not the preferred approach, it is an improvement over a pure time series regression model.

[3] By basing the forecasts on years where economic conditions were considerably weaker than usual, the forecasts will not account for the expected pick-up in economic activity over the Review period.

[4] That is, the regressions were conducted on 2002 to 2010 data, with the model coefficients used to 'forecast' 2011-2013 consumption. This in-sample forecast period was then compared against actual consumption in 2011-2013.

2.3.1 Use of GSP as a forecasting parameter

In its 2012 gas demand forecast prepared for Envestra's Victorian and Albury networks[5] Core included a GSP-driven parameter in its forecasts and, as noted above, ACIL Allen has identified that GSP is one of the two most relevant drivers of gas consumption.

Core also took this view in its March 2012 gas demand forecast for Envestra in Victoria where it explicitly included GSP in the forecasts, noting that *Core has identified GSP as being a primary driver of future commercial and industrial gas demand. As such projections of GSP are used as a basis for projected demand per connection.* [6]

The risk is that by not including GSP (or state final demand) is that forecasts of usage may be understated as forecasts of NSW GSP growth are generally healthier than recent outcomes. Deloitte Access Economics forecasts an average GSP growth of 2.5% annually across the 7 year outlook period, compared with an average 1.9% in the last 5 years.

The models we have adopted for the residential and I&C customer groups explicitly include state final demand as a parameter. However, the model underlying the small business consumption per customer forecasts was not changed from that adopted by Core – the strength of the downward trend over the historical period was larger than the effect of any potential explanatory variables (including price and economic conditions). Without accurately addressing the drivers of this trend (such as the closure of small scale manufacturers), the structural econometric equation for this customer group did not produce reliable results.

See Chapter 4 for the regression results.

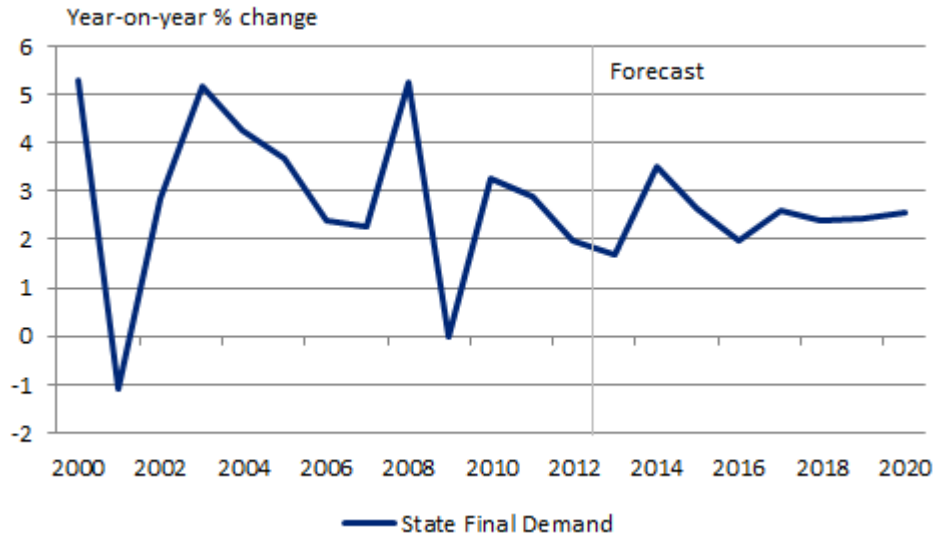
2.3.2 Economic forecasts

With the introduction of economic variables to the forecasting model it was necessary to also produce forecasts for both NSW Gross State Product (GSP) and State Final Demand (SFD). As Chart 2.1 and Chart 2.2 (below) illustrate, Deloitte Access Economics is expecting both GSP and SFD to be generally higher over the Review Period than has been seen over the last five years (albeit with some volatility), in line with expectations about a return to more solid economic conditions in NSW.

[5] Core Energy, Demand, Energy and Customer Forecasts, Envestra Limited – Gas Access Arrangement Review Victoria and Albury Networks (2013 to 2017), March 2012

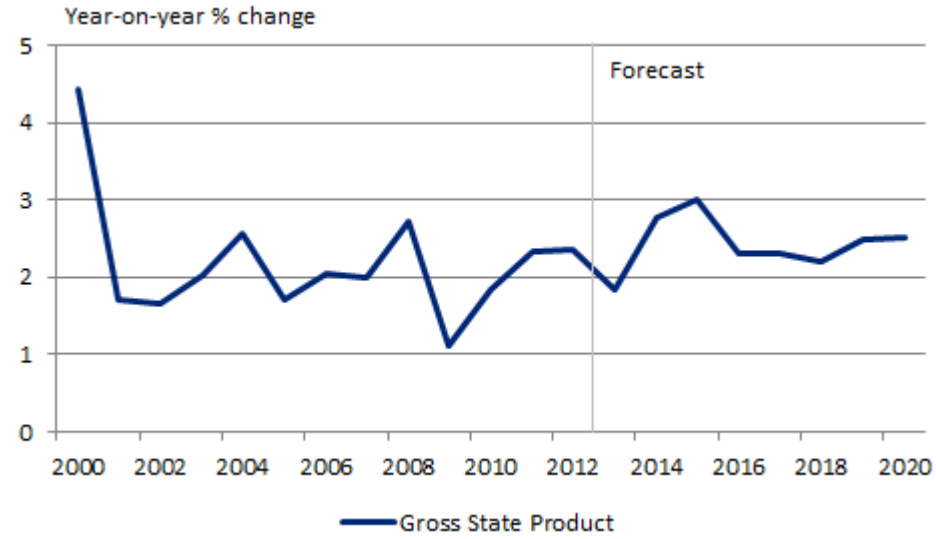
[6] Ibid., p. 33.

Chart 2.1: NSW State Final Demand



Source: Australia Bureau of Statistics and Deloitte Access Economics

Chart 2.2: NSW Gross State Product



Source: Australia Bureau of Statistics and Deloitte Access Economics

3 Customer numbers

This chapter sets out the Core assumptions regarding customer connections and disconnections and the approach we have adopted in preparing our alternative forecast.

3.1 Tariff V residential

3.1.1 Core approach and forecast

Consistent with standard practice, Core's forecasts of Tariff V residential connections are built up from base year 2012-13 customer numbers and simply add new connections and subtract disconnections. New connections have been separated into three categories:

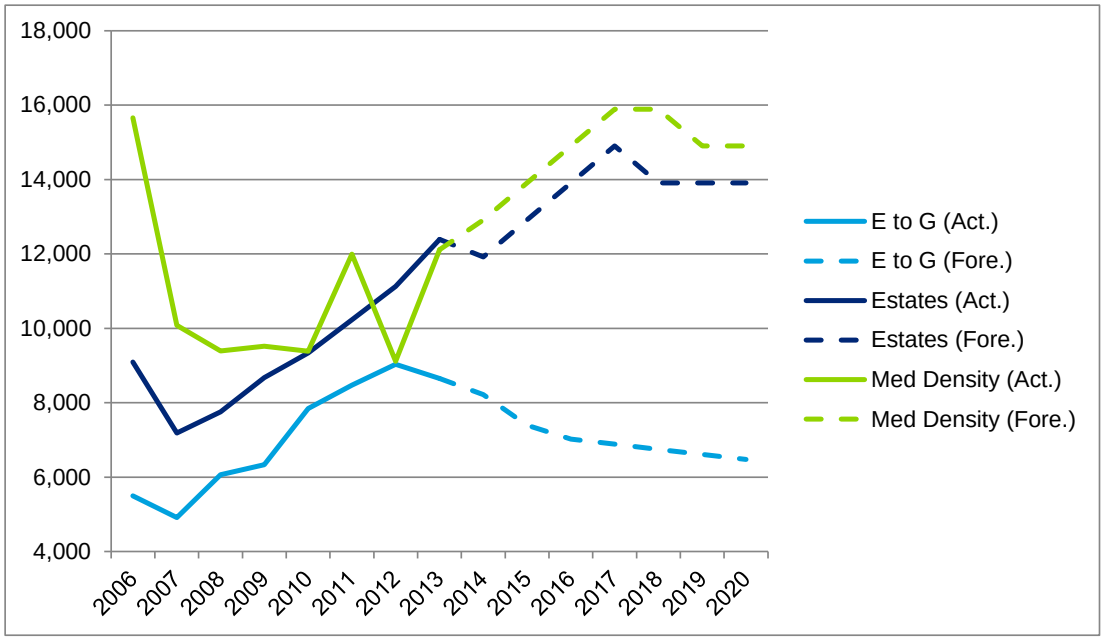
- Customer switching from a pure electricity household to one which is also connected to gas ('E to G' customers). Core considers that the impact of JGN's marketing activities is the key influence on new E to Gs. The forecast of new E to Gs is predicted to decline from 2012-13 levels as relatively higher gas prices mean the impact of marketing activities is lower
- New dwellings – new estates
- New dwellings – medium/high density.

Forecasts of new dwellings connections are based on both demand and supply side factors, with a 'catch-up' assumed to meet the existing dwelling stock deficiency in NSW.

Core has also assumed that 52% of these new dwellings will be medium/high density while 48% will be in new estates.

Core's forecasts result in sharply higher forecasts of new estate and medium density connections compared to the current regulatory period, and sharply lower E to G connections.

Chart 3.1 New residential connections – Core forecast



3.1.2 Total new connections

The approach of combining both supply side and demand side factors to arrive at estimates of new dwellings is somewhat novel. A more orthodox approach would simply be to use forecasts of new dwellings to determine the forecast.

Having said this, Deloitte agrees that new dwelling completions in NSW are likely to be higher in the short to medium term than historic levels. Deloitte's own dwelling expenditure forecasts shows this and recent forecasts from the Housing Industry Association (HIA) also confirm this point. For example, new dwelling starts in 2015 are expected to be 66% higher than in 2012.

Table 3.1: HIA new dwelling commencements in NSW ('000)

FY ending	2010 Act.	2011 Act.	2012 Act.	2013 Act.	2014	2015	2016	2017	2018
Houses	17.68	16.13	15.52	18.08	20.82	21.21	21.66	21.00	20.52
Multi-units	17.54	16.37	15.17	22.12	27.72	29.27	26.94	24.44	25.55
Total	**35.22**	**32.50**	**30.69**	**40.20**	**48.54**	**50.48**	**48.6**	**45.44**	**46.07**
Multi-units %	49.8%	50.4%	49.4%	55.0%	57.1%	58.0%	55.4%	53.8%	55.5%

Source: HIA August 2014 forecast.

We have reviewed the new connection forecasts prepared by Core against the August 2014 HIA dwelling commencement figures, recognising that there will be a lag between the time building a dwelling starts and a customer receiving their first bill. We also note that the HIA forecasts only go out to 2017/18, while the access arrangement period ends in

2019/20. Although the new connection figures appear somewhat low over the early part of the regulatory period, and slightly high at the end of the regulatory period, in aggregate they appear reasonable. New connections have averaged around 62% of HIA dwelling starts in recent years and Core's forecasts provide for an average of 60% going forward (assuming new dwelling commencements are at 2017/18 levels in 2018/19 and 2019/20)

We also note that Core has argued that the percentage of new dwellings connected to gas will reduce in future due to the declining competitiveness of gas. We agree that this may be the case.

We therefore consider the forecast of total new residential connections is reasonable.

3.1.3 Proportion of new estates versus medium density

Core's forecast provides that 48% of connections will be in new estates with 52% medium density.

JGN's proportion of connections in new estates is shown in the following table. On average it has been 50% over the past 5 years. This is the same average proportion of new houses versus multi unit dwellings reflected in the HIA's dwelling start data.

Table 3.2: Percentage of new connections in new estates

	2009	2010	2011	2012	2013	Average
JGN proportion of new customers in estates	47.7%	49.9%	46.0%	55.0%	50.6%	50.2%
HIA houses as proportion of total dwelling starts	56.0%	50.2%	49.6%	50.6%	45.0%	50.3%

We agree with JGN that an increasing proportion of new connections are likely to be in medium density developments. However, it is possible that the Jemena forecasts understate the proportion of new connections that will be medium density, as the HIA forecasts shown in Table 3.1 suggest that an average of 56% of new housing starts will be new dwellings. Given the high level of concordance between the Jemena medium density and the HIA new dwelling start data, our alternative forecast adopts an assumption of 56% medium density dwellings.

3.1.4 E to G

E to G conversions have been steadily increasing since 2007, with the exception of a 4% decline in 2013. Core's forecast suggests that E to G conversions peaked in 2012 and will steadily decline over the forecast period. This is based on an assumed reduction in marketing impact (expenditure is assumed to be constant in real terms) as 'the relative price outlook of gas vs electricity moves in favour of electricity'.[7]

[7] Appendix 5.1, p. 55

Table 3.3: Core forecast impact of marketing on number of E to G connections

2014	2015	2016	2017	2018	2019	2020
-5%	-10%	-5%	-2%	-2%	-2%	-2%

We agree with Core that the price competitiveness of gas will decline over the Access Arrangement period. It seems reasonable, as Core has argued, that the relative gas versus electricity price is a key determinant of E to G conversions (along with the price of appliances), although our review of the literature was unable to identify any firm data on this in the Australian context.

In our original report we expressed some concern about the, in our view, relatively arbitrary reduction in E to G connections proposed by Core. In response Core disagreed that the adjustments were arbitrary, and suggested they were the result of 'careful consideration' by Core and Jemena, although no additional data or quantitative information was provided to support this assertion.

It is therefore difficult to determine whether Core's forecasts of reductions in E to G transfers are reasonable, and if not, what a reasonable forecast might be. Our view on this matter is therefore influenced by Core's indication that in 2013/14 there had been an 18% reduction in E to G conversions. While the reasons for this were not disclosed, this is a significant fall and as Core indicated 'accounts for a significant proportion of the first three year cumulative reduction forecast by Core.' On this basis we have not made any adjustment to Core's forecast.

3.2 Tariff V business customers

3.2.1 Approach and forecast

Core has indicated that its approach to forecasting new connections for small business and I&C customers was to:[8]

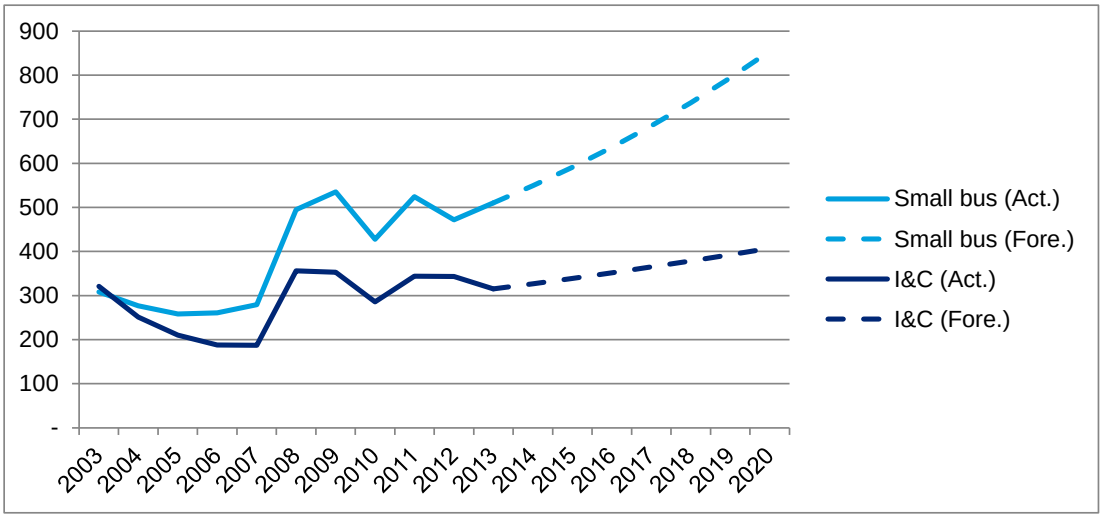
- Estimate new connections based on the historical trend (the cumulative average growth rate (CAGR) since 2003)
- Adjust for expected movements between Tariff V and Tariff D.

Actual and forecast new connection numbers for the small business and I&C categories are shown below. In both cases the actual new connections show a pattern of:

- Falling or stable annual new connection numbers (in the range of 200-300) until 2007
- A sharp increase in 2008, with new connections generally stable since then (aside from a dip in 2010)

[8] Appendix 5.1, p. 38

Chart 3.2 New non-residential connections – Core forecast



We consider that Core's approach of using the cumulative average growth rate in new connections since 2003 may overstate the forecasts of new small business connections and hence is not reasonable. This is because using a longer term CAGR appears to ignore the 'step change' in new connections that occurred around 2008. While the economic outlook for NSW is strong, in our view it is unreasonable to expect the number of new small business connections to be approaching double that of 2012/13 in 2019/20.

Further, it seems inconsistent to argue on the one hand that gas will become relatively less competitive but on the other that new small business connections will increase to historically high levels.

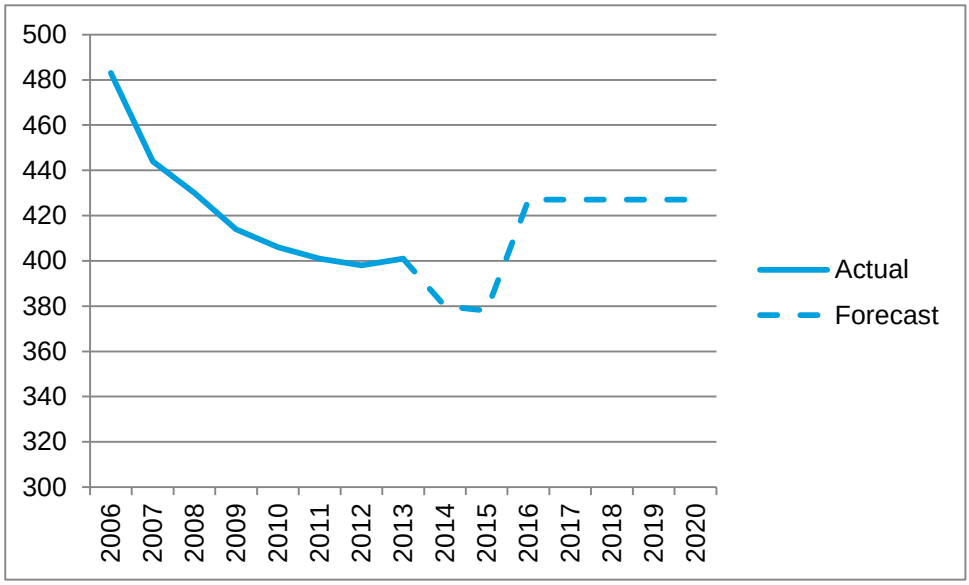
We have therefore developed an alternative forecast of new small business connections. We are aware of the issues associated with 'selectively' using particular historic years as the starting point for forecasts. Nevertheless, we consider a more reasonable forecast is likely to be achieved by projecting forward using 2008 as the starting point, rather than 2003.

3.3 Tariff D

3.3.1 Approach and forecast

Tariff D customer numbers are based on JGN's knowledge of new customer connections and closures, as well as net known movements between Tariff D and V. This results in a large decrease in 2014 with a number of customers forecast to shut down as well as some customers moving from Tariff D to Tariff V. In 2016, 49 customers are assumed to join as a result of switching from Tariff V to Tariff D.

Chart 3.3:Total Tariff D connections – Core forecast



We have discussed with Core the basis for the forecasts including the assumptions regarding the transition of Tariff V to Tariff D customers. We are satisfied they are reasonable.

3.4 Disconnections

Core has forecast increasing number of disconnections over the next regulatory period, at levels generally higher than in the current regulatory period. Residential disconnection figures in the current regulatory period show no clear trend.

In its forecast Core notes that:

- For residential classes, the long-term historical average disconnection rate (2002 to 2013) was used as the basis of future disconnections[9]
- For small business and I&C classes longer term historical disconnections were unreliable due to a large number of dormant supply points which caused a high disconnection rate prior to 2010. Hence 2010 to 2013 disconnections were used as the basis for forecasts. [10]

[9] Appendix 5.1, p. 32

[10] Appendix 5.1, p. 38

Chart 3.4: Residential disconnections – Core forecast

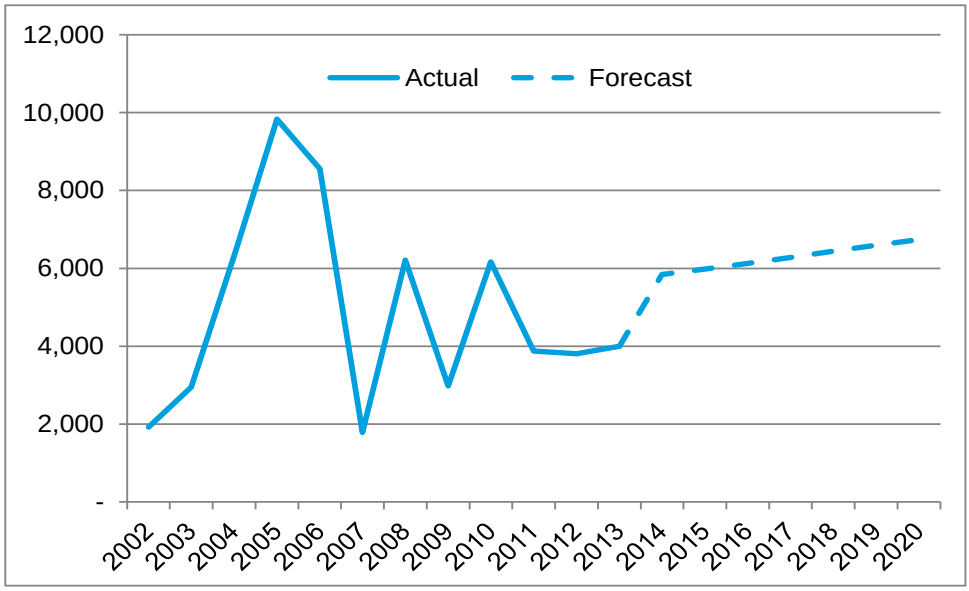
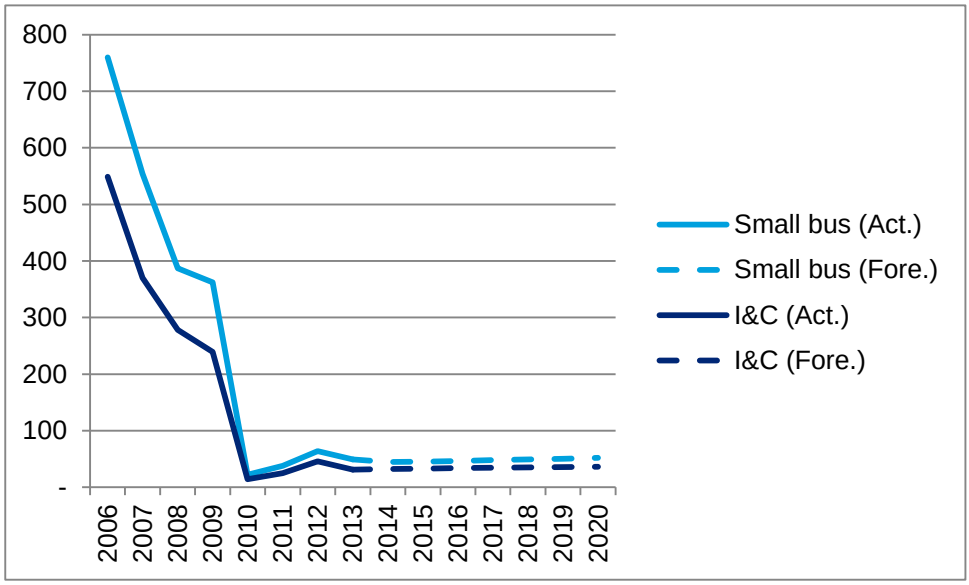


Chart 3.5: Small business and I&C disconnections – Core forecast



Core's approach to non-residential disconnections and the subsequent forecast appears reasonable. We support using 2010-2013 disconnections as the basis for the forecast

Core's approach to residential disconnections results in a 'step increase' in disconnections, which have been between 3,800 and 4,000 for each of the past 3 years, to over 5,800 in 2014. This is an increase of approximately 50% and in our original report we questioned whether the same issue may exist for residential as for non-residential connections: i.e. 'dormant' connections causing higher disconnections in earlier years.

In response Core argued that recent disconnections were not a guide to future disconnections as gas prices have remained low while electricity prices have increased. And hence there was no driving force.

We have noted Core's arguments but still regard the forecasts of disconnections as unreasonably high, particularly in the absence of data for 2014 supporting the large increase proposed by Core.

In our view a more reasonable approach is use the same approach to forecasting residential disconnections as for non-residential disconnections: i.e. use the average of the past 3 years only.

3.5 Summary of adjustments

The table below summarises the adjustments we have made to the customer number forecasts.

Table 3.4: Changes to customer number assumptions

Assumption	Amendment
Residential	
Disconnections	Based on average % of 2011-2013 rather than average % of 2002-2013
New estates versus medium density	56% of new connections assumed to be medium density rather than 52%
Small business	
Connections	Based on average % of 2011-2013 rather than average % of 2002-2013
I&C	No change

Source: Deloitte Access Economics

Table 3.5 to Table 3.7 presents the revised customer number forecasts. We have increased the residential connections slightly (though reducing disconnections), reduced the small business forecast and made no change to the I&C forecast.

Table 3.5: Tariff V Residential – customer number forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	1,103,184	1,136,607							
Deloitte forecast			1,165,132	1,195,151	1,226,679	1,259,940	1,291,950	1,322,717	1,353,240
Core forecast			1,163,815	1,192,049	1,221,754	1,253,153	1,283,259	1,312,083	1,340,626
Difference (%)			*0.1%*	*0.3%*	*0.4%*	*0.5%*	*0.7%*	*0.8%*	*0.9%*

Source: Deloitte Access Economics

Table 3.6: Tariff V Small Business Customers – customer number forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020

Actual	20,941	21,581							
Deloitte forecast			22,039	22,488	22,944	23,396	23,847	24,298	24,748
Core forecast			22,086	22,631	23,221	23,858	24,546	25,290	26,092
Difference (%)			*-0.2%*	*-0.6%*	*-1.2%*	*-1.9%*	*-2.8%*	*-3.9%*	*-5.2%*

Source: Deloitte Access Economics

Table 3.7: Tariff V Small Business Customers – customer number forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	15,188	15,933							
Deloitte forecast			16,244	16,551	16,820	17,151	17,494	17,851	18,222
Core forecast			16,244	16,551	16,820	17,151	17,494	17,851	18,222
Difference (%)			*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*	*0.0%*

Source: Deloitte Access Economics

4 Revised consumption per customer forecasts

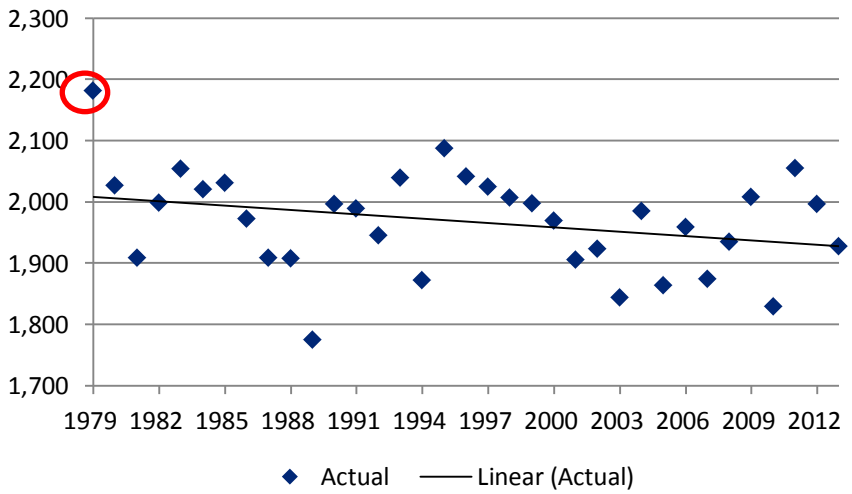
This chapter reviews the Core approach to establishing per customer usage forecasts and sets out the methodology we have used to calculate our alternative forecast.

4.1 Weather normalisation

'Normalising' historic usage to take into account weather is an important step in forecasting per customer usage. Core has used the Effective Degree Day (EDD) method for determining actual and forecast weather. The EDD concept has been used in Victoria for some time and is a measure of coldness (which is directly related to gas demand for space heating) The EDD is a composite index which incorporates the effect of temperature, windchill, insolation and season. Although we note that gas use for space heating is less widespread in NSW compared to Victoria, we consider it is still reasonable to use this measure in this case.

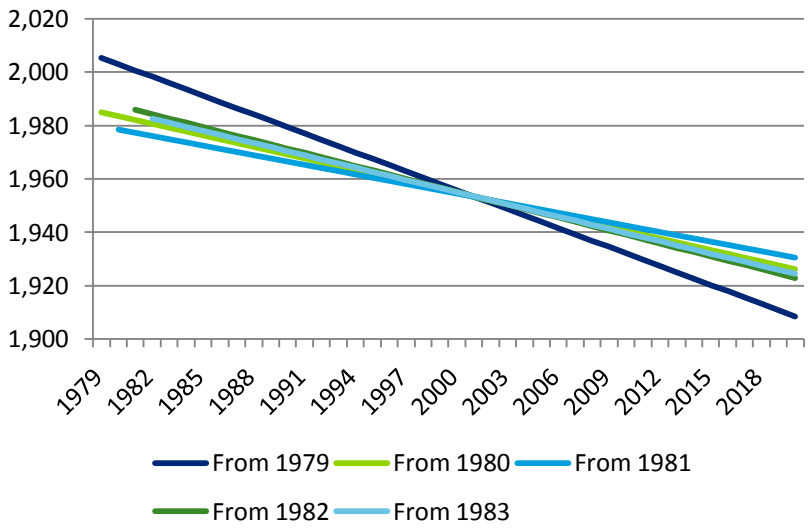
Core has calculated the linear trend in historical EDD based on annual data from 1979 to 2013, however we note the first year is a clear outlier in the data.

Chart 4.1: EDD – trend beginning from 1979



The chart below presents the linear trend in EDD when the starting year is varied between 1979 and 1983. The starting point bias of 1979 is clearly evident – where the other years following a broadly similar trend, 1979 has a much stronger downward trend.

Chart 4.2: EDD trend with different starting years



The table and charts below demonstrate the impact of the starting point on the slope and intercept coefficients used to develop normalised EDD.

Table 4.1: Starting point bias - impact on EDD trend

	From 1979	From 1980	From 1981	From 1982	From 1983	From 1984
Observations	35	34	33	32	31	30
X-variable coefficient	-2.36	-1.43	-1.19	-1.61	-1.53	-1.04
Intercept coefficient	2012.45	1989.21	1983.14	1993.91	1991.77	1978.87

Chart 4.3: Impact of starting point of intercept coefficient

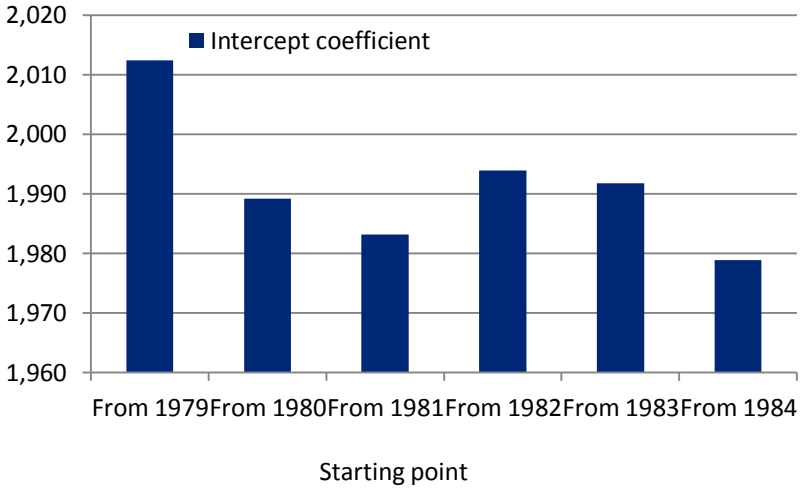
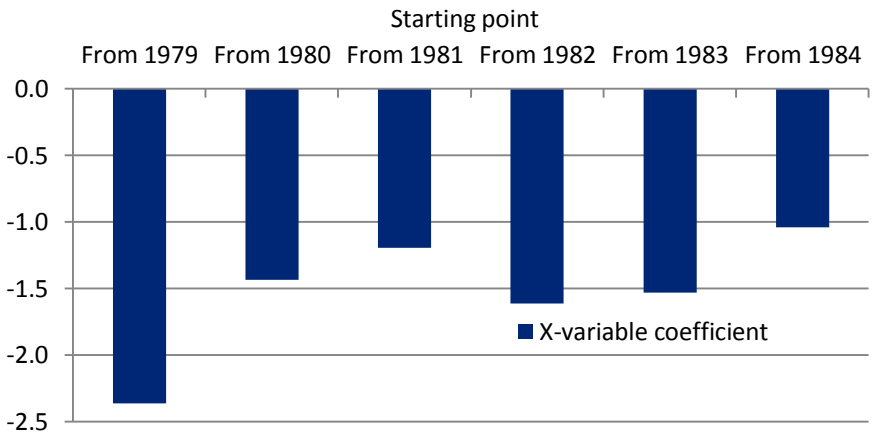


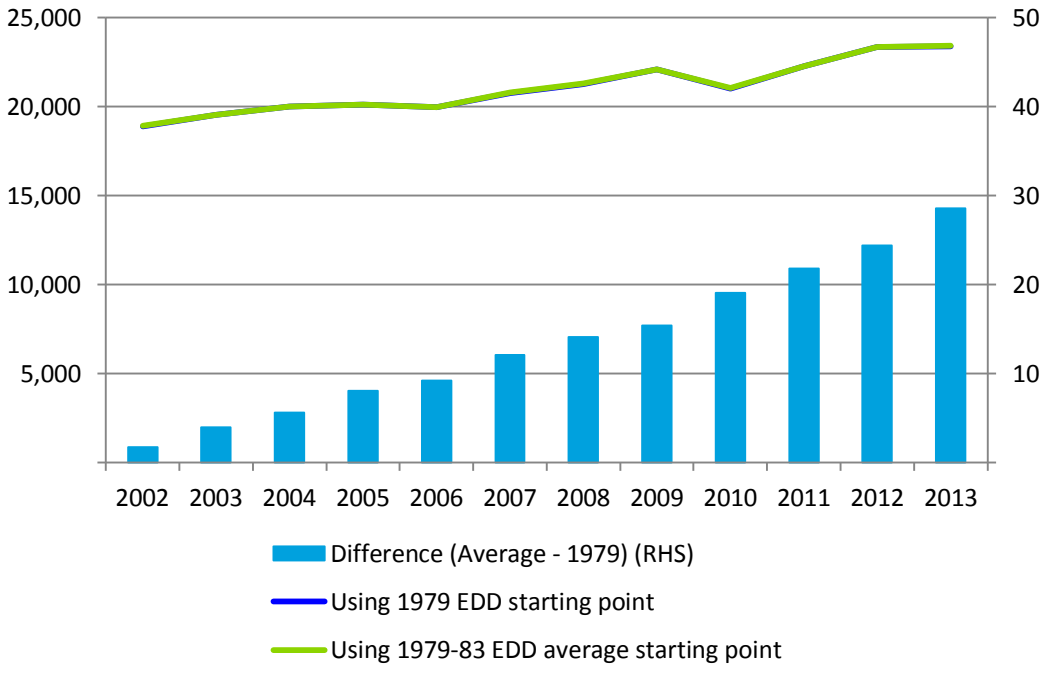
Chart 4.4: Impact of starting point on X-variable coefficient



The linear trend in historical EDD is used to develop normalised EDD. The difference between historical EDD and normalised EDD is multiplied by an annual 'sensitivity factor' (simple linear regression of EDD on consumption per connection) and the total number of connections. This gives 'residential abnormal demand'. 'Residential normalised demand' is 'residential actual demand' minus abnormal demand.

The chart below presents the difference in residential normalised demand between i) using 1979 as the starting point for EDD historical demand, and ii) using an average of 1979 to 1983 starting points as historical EDD.

Chart 4.5: Residential normalised demand (TJ) under different EDD starting point assumptions



While the starting point of 1979 has been shown to impact on estimated normalised residential demand, the magnitude of the impact in relation to total residential demand is small. This is worth noting; however it is not expected to have a material effect on the forecasts. We therefore consider the approach used to be reasonable.

4.2 Revised approach to forecasting consumption per customer

As explained in Section 2.3.1, the analysis presented here is based on a structural (economic) econometric regression of the key drivers of gas consumption, to the extent that data was available. The results of the regression analysis are presented below, with the forecasts presented in the subsequent section (4.5).

We tested a range of models and parameters before landing at our preferred econometric model.

4.2.1 Tariff V Residential

The preferred Tariff V Residential consumption per customer (Y_t) model is presented in Equation 1, where $\propto$ is a constant, P_t is the gas price (bills), P_{t-1} is the gas price (bills) in the previous period (year), SFD_{t-1} is the annual change in NSW State Final Demand in the previous period (year), the βs are regression coefficients and ε_t is the error term. Consumption and price were entered into the regression as natural logarithms.

$$lnY_t = \propto + \beta_1 \ln(P_t) + \beta_2 \ln(P_{t-1}) + \beta_3 SFD_{t-1} + \varepsilon_t \quad (1)$$

Table 4.2 presents the regression results:

- All else equal, a 1% increase in price this period corresponds to a 0.32% reduction in consumption;
- All else equal, a 1% increase in price last period corresponds to a 0.13% reduction in consumption;
- All else equal, a 1 percentage point increase in NSW State Final Demand (in the previous year) (annual % change) corresponds to a 0.01% increase in consumption.

Table 4.2: Tariff V Residential – econometric regression results

Variable	Coefficient	p-value
Constant	5.8754	0.0030**
Gas bills (price)	-0.3202	0.2735
Gas bills (price) (lagged one period)	-0.1278	0.2587
Annual change in State Final Demand (lagged one period)	0.0116	0.0143**
R-squared	0.8963	
F-statistic (p-value)	0.0068**	

*Denotes statistical significance at the 10% level of confidence; ** Denotes statistical significance at the 5% level of confidence
Source: Deloitte Access Economics

4.2.2 Tariff V I&C

The preferred Tariff V I&C consumption per customer (Y_t) model is presented in Equation 3, where $\propto$ is a constant, P_t is the gas price (bills), GSP_{t-1} is NSW Gross State Product in the previous period (year), the βs are regression coefficients and ε_t is the error term. Consumption and price were entered into the regression as natural logarithms.

$$lnY_t = \propto + \beta_1 \ln(P_t) + \beta_2 GSP_{t-1} + \varepsilon_t \quad (3)$$

Table 4.3 presents the regression results:

- All else equal, a 1% increase in price corresponds to a 0.36% reduction in consumption; and
- All else equal, a 1 percentage point increase in NSW Gross State Product (annual % change) corresponds to a 0.03% increase in consumption.

Table 4.3: Tariff V I&C – econometric regression results

Variable	Coefficient	p-value
Constant	8.5207	0.0001**
Gas bills (price)	-0.3559	0.0550**
Annual change in Gross State Product (lagged one period)	0.0272	0.1744
R-squared	0.5395	
F-statistic (p-value)	0.0977*	

*Denotes statistical significance at the 10% level of confidence; ** Denotes statistical significance at the 5% level of confidence; While the coefficient on GSP is not statistically significant, it is stable when subject to the inclusion and exclusion of other variables – given the small sample size, it has remained in the preferred model.
Source: Deloitte Access Economics

4.2.3 Tariff V Small Business

A similar approach to that for residential and I&C forecasts was first adopted to develop the Tariff V Small Business consumption per customer forecasts; however the strength of the downward trend over the historical period was larger than the effect of any potential explanatory variables (including price and economic conditions). Without accurately addressing the drivers of this trend (such as the closure of small scale manufacturers), the structural econometric equation for this customer group did not produce reliable and robust results.

Therefore, the model approach underlying the Tariff V Small Business consumption per customer forecasts produced by Core was not changed – future consumption per customer is driven by a strong downward trend that is adjusted to reflect own price and cross price elasticities.

However, where Core adopted a -3.2% downward trend (based on average annual growth between 2002 and 2013), the revised forecasts are based on a -2.5% average annual growth (based on trends between 2008 and 2013). This adjustment reflects the moderation (and arguably structural change) in Tariff V Small Business consumption per customer trends since 2008.

4.3 Prices, elasticities and demand for gas

Core's modelling predicts a large impact on volumes arising from higher gas prices (own price elasticity). It also predicts a smaller impact on volumes arising from electricity prices moving at different rates to gas prices (cross-price elasticity). The impacts are summarised in Table 4.4.

Table 4.4: Price elasticity impacts – Core[11]

	2014	2015	2016	2017	2018	2019	2020
Residential							
Own price	-2.4%	-2.4%	-0.9%	-0.6%	-0.8%	-0.3%	0.0%
Cross price	0.4%	-0.1%	-1.0%	0.0%	0.0%	0.0%	0.0%
Total	**-2.0%**	**-2.5%**	**-1.9%**	**-0.5%**	**-0.8%**	**-0.3%**	**0.0%**
Small Business and I&C							
Own price	-3.3%	-3.0%	-2.1%	-0.5%	-1.0%	-1.5%	-0.6%
Cross price	0.4%	-0.1%	-1.0%	0.0%	0.0%	0.0%	0.0%
Total	**-3.0%**	**-3.1%**	**-3.1%**	**-0.5%**	**-1.0%**	**-1.5%**	**-0.6%**

Own price elasticity – Core

Core has adopted (long run) own price elasticity estimates of -0.30 for residential gas usage and -0.35 for non-residential gas usage. These elasticity estimates were accepted as reasonable by the AER in its review of Envestra's Victorian gas demand forecasts, based on previous studies and analysis of data.

Core's own modelling did not produce statistically significant estimates of own price elasticity in the NSW gas market. However, the estimates that were generated were broadly consistent with the estimates used in the Envestra forecast.

However, as explained in section 2.3.1, by utilising a time series approach to forecasting consumption Core reduced the potential for other explanatory variables (such as price) to have a significant impact on consumption (that is, consumption last period dominates the forecast equation for consumption this period). The revised approach adopted here is based on a structural relationship between consumption and price and therefore a revised set of own price elasticities have been developed.

Cross price elasticity – Core

Core also adopted a cross-price elasticity of 0.1. While Core noted that no previous gas forecasts have incorporated cross price elasticity, it considers that the material forecast change in gas prices relative to electricity warrants inclusion in this case.

[11] Appendix 5.1, p. 87

The adopted value of 0.1 appears to reflect US studies, which have found cross-price elasticity of gas demand, with respect to changes in electricity prices, ranging up to 0.15.

In its report to AEMO ACIL Allen noted that CiE was unable to quantity cross-elasticity of demand in its 2012 work for SP AusNet.[12] ACIL Allen concluded more generally that cross-elasticity had not, to its knowledge, previously been found to be significant in gas forecasting models, at least partly due to data issues. ACIL Allen noted that it was a factor that AEMO may wish to examine more closely in future, but effectively ruled out including it in its gas forecasting methodology in the short term.

Furthermore, we note that the forecasts developed recently by the NSW electricity distribution businesses as part of their price review process have not included an assessment of cross price elasticity (with gas) and, therefore, this demand is essentially being 'lost' from a regulatory perspective.

In response to our original report, which indicated a preference for a cross price elasticity of zero given the lack of empirical evidence in an Australian context, Core argued that:

- Cross price elasticity is widely accepted as a legitimate approach to assessing the impact of price increases on demand where substitutes exist
- There has not been a material divergence between gas and electricity prices in the past and therefore one would not expect to observe cross-price elasticity
- ACIL Allen indicated that in future increasing gas prices relative to electricity is likely to reveal the cross-elasticity of substitute products.

Our concern with using a material cross-price elasticity estimate is the lack of Australian evidence to support it. At the same time it is clear there will be a non-zero demand response if, as expected, electricity become materially cheaper relative to gas. In arriving at a position in respect of cross-price elasticity we have taken into account:

- In terms of responsiveness, we would expect residential customers to have a greater short-term ability to switch between gas and electricity, while I&C customers may need to amend production processes or other business infrastructure in order to make the change. Indeed we note that Core's application of own-price elasticity assumes a lag in responsiveness on behalf of non-residential customers. Thus any shift in usage as a result of cross-price elasticity will not be fully felt immediately
- Our forecasts already take into account an own-price elasticity effect of 0.45 (after two years) for residential usage and 0.36 for I&C usage, which is higher than the Core assumptions
- The 'price' of alternative (largely green) energy products, such as solar, are likely to rise in the upcoming regulatory period compared to the previous period as subsidies and other factors making them attractive are reduced or eliminated.

On balance, our view is that it is reasonable to include an estimate of cross-price elasticity in the forecasts, but that the relatively small value of 0.05, is more reasonable than the 0.1 proposed by Core and avoids any risk of double-counting.

[12] ACIL Allen Report to AEMO, Gas Consumption Forecasting – A Methodology, 24 June 2014, p. 41

Carbon price

Since Core's forecasts were made, legislation to abolish the carbon tax has passed through the Australian Parliament. This will reduce both gas and electricity prices relative to their current level, although the impact on electricity prices will be greater due to its greater (average) carbon intensity.

As such, Core was asked to develop revised gas and electricity price series to reflect the removal of the carbon tax. Table 4.5 presents the revised gas bills data series.

Table 4.5: Gas bills ($2013)

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Residential	684	764	817	834	824	837	872	864	856
Non-residential	684	764	817	817	808	839	908	902	895

Source: Core

4.4 Summary of adjustments

Table 4.6 provides an overview of the revised price assumptions adopted for the updated forecasts.

Table 4.6: Revised price assumptions

Assumption	Detail
Own price elasticity	Elasticities based on regression results (not estimates from the literature)
Cross price elasticity	Moderated to 0.05%
Carbon price removed	See Table 4.5 for revised gas bills series

Source: Deloitte Access Economics

4.5 Revised consumption per customer forecasts

The following tables present the revised consumption per customer forecasts for Jemena's NSW gas distribution network, based on the discussion set out above. Note that these are based on Core's weather normalised series.

Table 4.7: Tariff V Residential – consumption per customer forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	21.14	20.57							
Deloitte forecast			19.69	19.68	19.29	18.97	18.71	18.52	18.51
Core forecast			19.84	19.07	18.45	18.07	17.68	17.39	17.15
Difference (%)			*-0.76%*	*3.20%*	*4.55%*	*4.98%*	*5.83%*	*6.50%*	*7.93%*

Source: Deloitte Access Economics

Table 4.8: Tariff V I&C – consumption per customer forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	524.37	493.42							
Deloitte forecast			487.76	499.38	460.61	445.68	433.10	433.73	439.15
Core forecast			485.24	465.11	404.82	398.41	390.16	379.96	373.60
Difference (%)			*0.52%*	*7.37%*	*13.78%*	*11.87%*	*11.01%*	*14.15%*	*17.54%*

Source: Deloitte Access Economics

Table 4.9: Tariff V Small Business – consumption per customer forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	247.09	244.22							
Deloitte forecast			230.39	218.77	210.04	203.93	196.52	188.46	182.43
Core forecast			229.10	214.61	201.18	193.62	185.45	176.70	169.89
Difference (%)			*0.56%*	*1.94%*	*4.40%*	*5.32%*	*5.97%*	*6.66%*	*7.38%*

Source: Deloitte Access Economics

5 Revised consumption forecasts

5.1 Tariff V by customer type

Based on the forecasts of customers and consumption per customer presented chapters 3 and 4, the tables below summarise our alternative forecasts for total consumption.

Table 5.1: Tariff V Residential – total consumption forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	23,320,712	23,375,250							
Deloitte forecast			22,950,973	23,524,143	23,671,088	23,903,281	24,176,830	24,502,908	25,060,611
Core forecast			23,092,505	22,736,962	22,535,845	22,644,314	22,687,131	22,820,905	22,996,609
Difference (%)			*-0.61%*	*3.46%*	*5.04%*	*5.56%*	*6.57%*	*7.37%*	*8.98%*

Source: Deloitte Access Economics

Table 5.2: Tariff V Small Business Customers – total consumption forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	5,174,320	5,270,576							
Deloitte forecast			5,077,456	4,919,748	4,819,054	4,771,084	4,686,334	4,579,236	4,514,769
Core forecast			5,059,748	4,856,832	4,671,596	4,619,335	4,552,256	4,468,591	4,432,905
Difference (%)			*0.35%*	*1.30%*	*3.16%*	*3.29%*	*2.95%*	*2.48%*	*1.85%*

Source: Deloitte Access Economics

Table 5.3: Tariff V I&C – total consumption forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	7,964,175	7,861,616							
Deloitte forecast			7,923,321	8,265,397	7,747,614	7,643,742	7,576,608	7,742,419	8,002,050
Core forecast			*7,882,384*	*7,698,139*	*6,809,061*	*6,832,957*	*6,825,440*	*6,782,586*	*6,807,666*
Difference (%)			*0.52%*	*7.37%*	*13.78%*	*11.87%*	*11.01%*	*14.15%*	*17.54%*

Source: Deloitte Access Economics

5.2 Total Tariff V consumption

Based on the forecasts of consumption by customer type presented, Table 5.4 presents the revised forecasts for total consumption.

Table 5.4: Total Tariff V consumption forecast

	2012	2013	2014	2015	2016	2017	2018	2019	2020
Actual	36,459,207	36,507,442							
Deloitte forecast			35,951,750	36,709,289	36,237,756	36,318,107	36,439,772	36,824,563	37,577,430
Core forecast			36,034,637	35,291,933	34,016,503	34,096,606	34,064,827	34,072,082	34,237,180
Difference (%)			*-0.23%*	*4.02%*	*6.53%*	*6.52%*	*6.97%*	*8.08%*	*9.76%*

Source: Deloitte Access Economics

Limitation of our work

General use restriction

This report is prepared solely for the internal use of Australian Energy Regulator (AER). This report is not intended to and should not be used or relied upon by anyone else and we accept no duty of care to any other person or entity. The report has been prepared for the purpose of the AER's review of Jemena Gas Networks' proposed Access Arrangement. You should not refer to or use our name or the advice for any other purpose.

Contact us

Deloitte Access Economics
ACN: 149 633 116

Level 1
9 Sydney Avenue
Barton ACT 2600
PO Box 6334
Kingston ACT 2604 Australia

Tel: +61 2 6175 2000
Fax: +61 2 6175 2001

www.deloitteaccesseconomics.com.au

Deloitte Access Economics is Australia's pre-eminent economics advisory practice and a member of Deloitte's global economics group. The Directors and staff of Access Economics joined Deloitte in early 2011.

About Deloitte

Deloitte refers to one or more of Deloitte Touche Tohmatsu Limited, a UK private company limited by guarantee, and its network of member firms, each of which is a legally separate and independent entity. Please see www.deloitte.com/au/about for a detailed description of the legal structure of Deloitte Touche Tohmatsu Limited and its member firms.

Deloitte provides audit, tax, consulting, and financial advisory services to public and private clients spanning multiple industries. With a globally connected network of member firms in more than 150 countries, Deloitte brings world-class capabilities and deep local expertise to help clients succeed wherever they operate. Deloitte's approximately 200,000 professionals are committed to becoming the standard of excellence.

About Deloitte Australia

In Australia, the member firm is the Australian partnership of Deloitte Touche Tohmatsu. As one of Australia's leading professional services firms. Deloitte Touche Tohmatsu and its affiliates provide audit, tax, consulting, and financial advisory services through approximately 6,000 people across the country. Focused on the creation of value and growth, and known as an employer of choice for innovative human resources programs, we are dedicated to helping our clients and our people excel. For more information, please visit our web site at www.deloitte.com.au.

Liability limited by a scheme approved under Professional Standards Legislation.

Member of Deloitte Touche Tohmatsu Limited

© 2014 Deloitte Access Economics Pty Ltd